

SECTION VII. SPACE EXPERIMENTS WITH
PARTICLE ACCELERATORS (SEPAC)

SPACE EXPERIMENTS WITH PARTICLE ACCELERATORS

SEPAC

STATUS REVIEW

SEPTEMBER 23, 1980

SEPAC DEVELOPMENT RESPONSIBILITIES

INSTITUTE OF SPACE AND AERONAUTICAL SCIENCE (ISAS), UNIVERSITY OF TOKYO

- ACCELERATOR SYSTEMS
 - ELECTRON BEAM ACCELERATOR
 - MAGNETO PLASMA DYNAMIC (MPD) ARCJET
- DIAGNOSTIC SYSTEMS
 - DIAGNOSTIC PACKAGE
 - MONITOR TELEVISION
- POWER SYSTEMS
 - BATTERY AND CHARGER
 - HIGH VOLTAGE CONVERTER

MARSHALL SPACE FLIGHT CENTER

- DEDICATED EXPERIMENT PROCESSOR
- INTERFACE UNIT
- CONTROL PANEL
- ALL FLIGHT SOFTWARE

SEPAC OPERATIONS

- AUTOMATED EXPERIMENTS (UNDER DEP COMMAND CONTROL)
 - 21 INDIVIDUAL EXPERIMENT ELEMENTS
 - EACH EXPERIMENT MAY HAVE PARAMETERS MODIFIED BEFORE THE EXPERIMENT OPERATIONS ARE BEGUN (E.G., PITCH ANGLE, CURRENT, ACCELERATION VOLTAGE, PULSE DURATION, PULSE INTERVAL)
 - TOTAL OF 50 PARAMETERS FOR EACH EXPERIMENT
 - PAYLOAD CREW PERFORMS ALL PARAMETER CHANGES
 - PAYLOAD CREW MONITORS STATUS OF ALL SEPAC INSTRUMENTS
 - PAYLOAD CREW IS INVOLVED IN THE EXPERIMENT PERFORMANCE THROUGH DATA DISPLAYS
 - GRAPHIC DISPLAY OF SAMPLE FROM DIAGNOSTIC INSTRUMENTS
 - TELEVISION MONITOR
- SEPAC MANUAL OPERATIONS (SMO)
 - PAYLOAD CREW MAY CONSTRUCT OTHER EXPERIMENTS USING SMO
 - THE SMO IS PRIMARILY USED TO PERFORM TEST OPERATIONS PRIOR TO EXPERIMENT OPERATIONS
 - THE SMO ALSO PERMITS OTHER EXPERIMENTS TO BE PERFORMED USING FEATURES SUCH AS EBA BEAM MODULATION (1 kHz or \sim 5 kHz)
 - THE SAME DATA DISPLAYS ARE AVAILABLE TO THE PAYLOAD CREW AS DURING AUTOMATED OPERATIONS
 - PAYLOAD CREW SELECTS SEPAC MODE OF SMO BY SETTING UP TO 25 SELECTABLE PARAMETERS

JOINT EXPERIMENTS ON THE FIRST SPACELAB MISSION

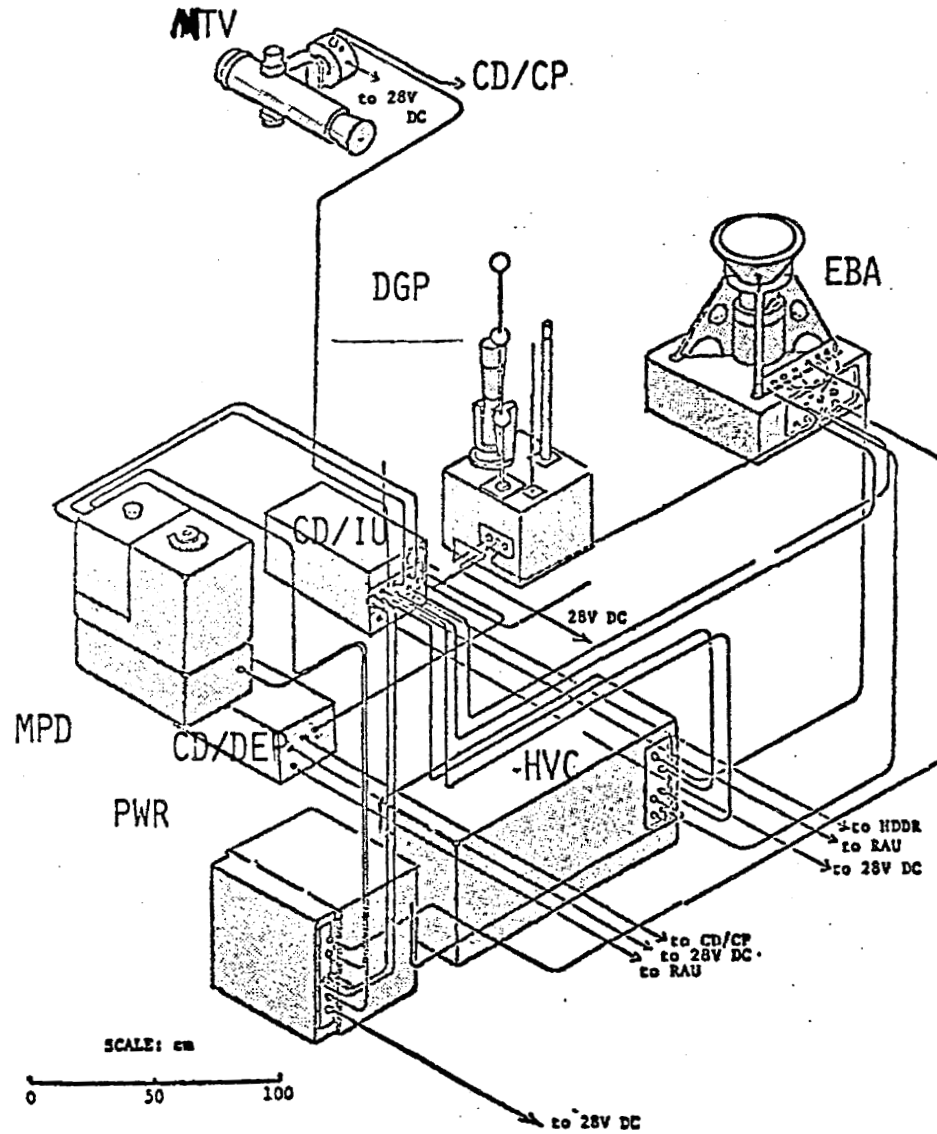
AEPI - THIS INSTRUMENT IS USED TO OBSERVE THE HIGH POWER EBA AND MPD FIRINGS (HARD WIRE LINK BETWEEN EXPERIMENTS)

ISO - THIS INSTRUMENT ALSO OBSERVES HIGH POWER EBA FIRINGS (PASSIVE COORDINATION)

ES019 - OBSERVES EBA INDUCED EFFECTS WHEN FIRINGS OCCUR (HARD WIRE LINK BETWEEN EXPERIMENTS)

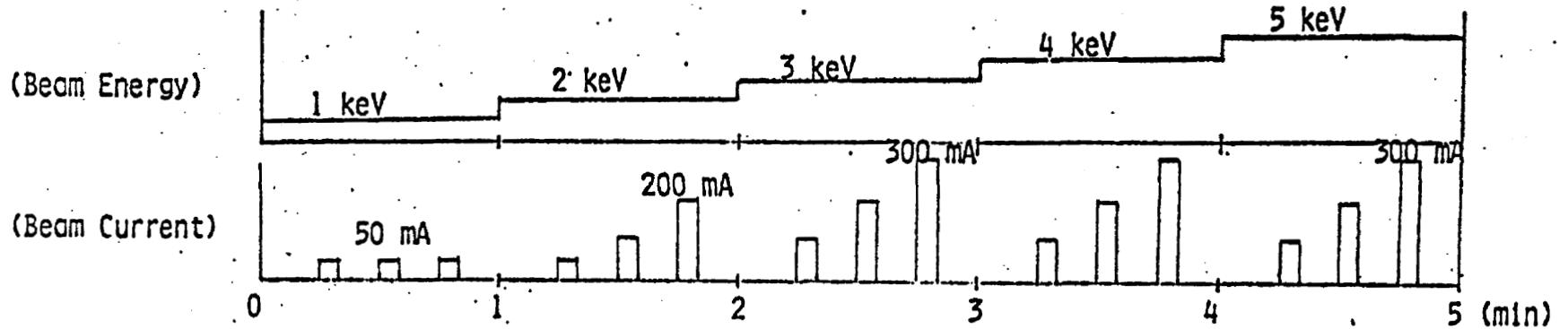
ES020 - SEPAC IS USED IN A DIAGNOSTIC MODE TO OBSERVE E-BEAM FIRINGS BY ES020

SEPAC System Configuration

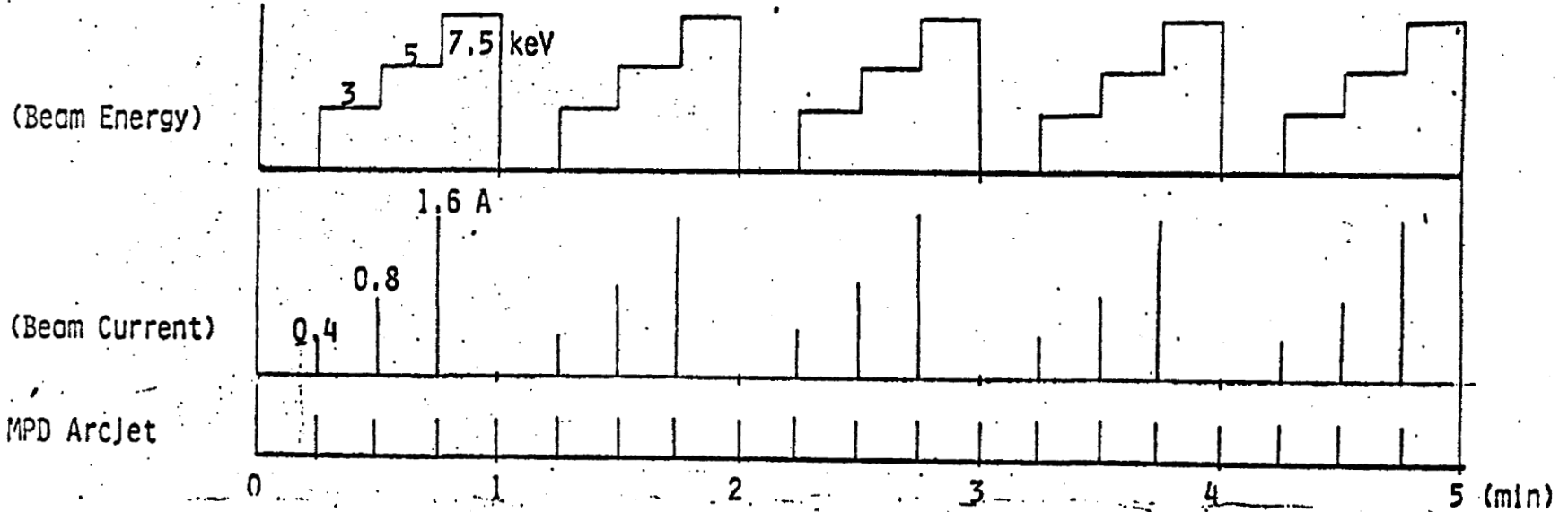


Typical Experiments

1) Low Power Electron Beam Experiment (F0-5)



11) High Power Electron Beam Experiment (F0-9 (A-5a))



Operation (Functional Objectives)

| | | |
|--------|-----|--|
| F.O.-1 | T-0 | SEPAC System Checkout |
| 2 | T-1 | EBA Firing Test (Level I) |
| 3 | T-2 | MPD Firing Test |
| 4 | T-3 | EBA Firing Test (Level II) |
| 5 | A-1 | Electron Beam Experiment 1 (Low Power (1 - 5 keV), CW and Pulse) |
| 6 | A-2 | Electron Beam Experiment 2 (Low Power (1 - 5 keV), EBA/NGP) |
| 7 | A-3 | Electron Beam Experiment 3 (Low Power (1 - 5 keV), EBA/MPD) |
| 8 | A-4 | Plasma Beam Propagation |
| 9 | A-5 | Artificial Aurora Excitation (High Power (3-7.5 keV) 0.5 sec ON 1.5 sec OFF 3 pulses in series Every 15 sec, EBA/MPD/NGP) |
| 10 | A-6 | Equatorial Aerochemistry |
| 11 | A-7 | Electron Echo Experiment (High Power (7.5 keV, 1.6 A) 0.5 sec ON/ Every 15 sec, EBA/MPD) |
| 12 | A-8 | E//B Experiment (High Power (1 - 7 keV, 0.08 - 1.0 A) 100 msec/Every 1 sec) |
| 13 | P-1 | Passive Experiment |
| 14 | P-2 | Passive Experiment (IES020 Support) |
| 15 | CFR | SEPAC System Deactivation |
| 16 | CHG | Battery Charging |

S E P A C Characteristics

Electron Beam Accelerator (EBA)

Beam Energy : 0 - 7.5 keV
Beam Current: 0 - 1.6 A
Pulse Width : 1 msec - 1 sec (High Power)
1 msec - CW (Low Power)

Magneto - Plasma - Dynamic Arcjet (MPD)

Energy Stored 2 kJ
Discharge Pulse Width 1 msec
No. of Ion / electron pairs / shot 10^{19} /shot
Repetition 15 sec
Gas Argon

Neutral Gas Plume Generator (NGP)

Gas Nitrogen